Fig. 1

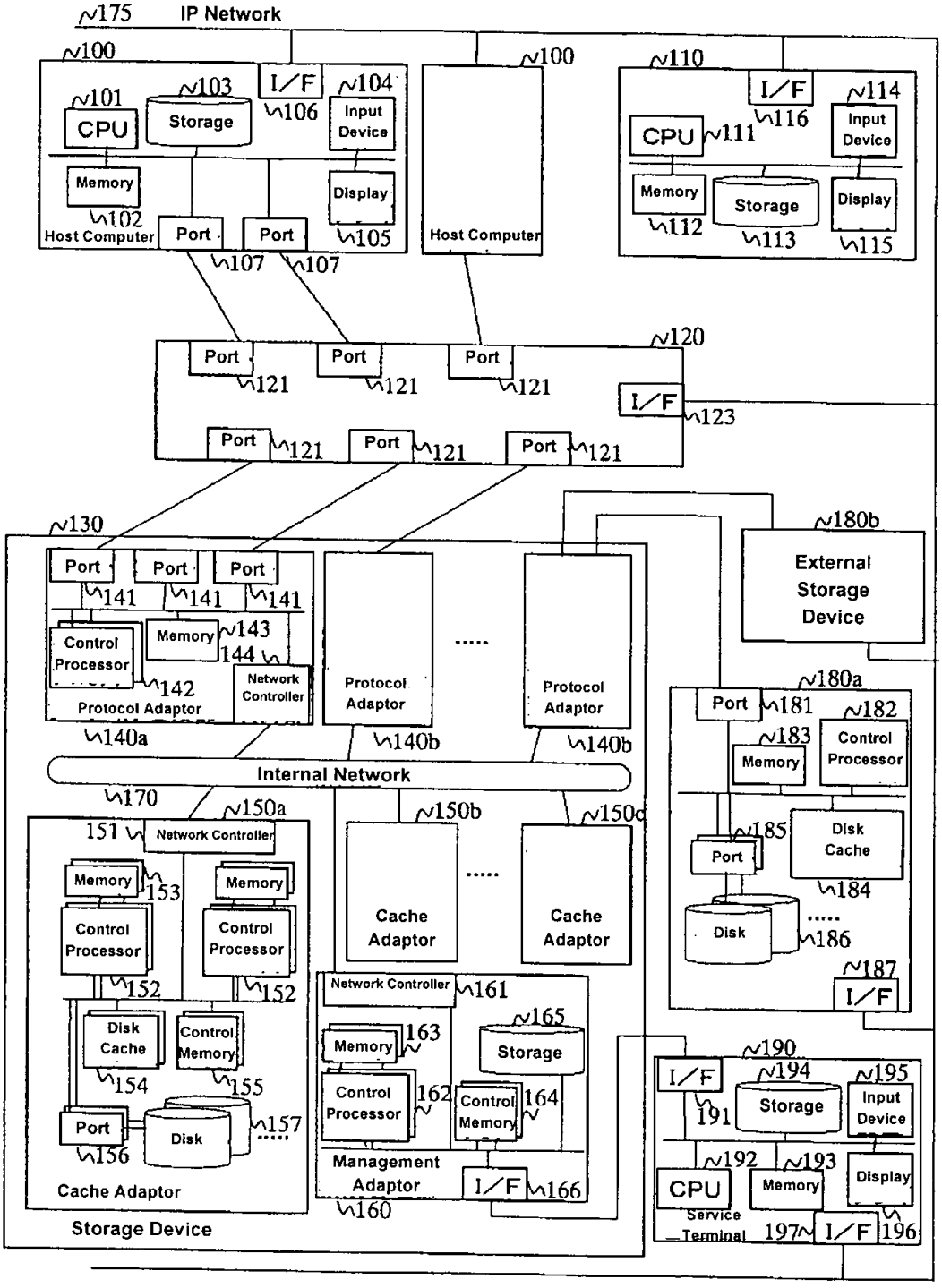

175
IP Network
100
101
CPU
103
Storage
I/F
106
104
Input Device
Memory
102
Host Computer
Port
107
Port
107
Display
105
100
Host Computer
110
I/F
116
114
Input Device
CPU
111
Memory
112
Storage
113
Display
115
120
Port
121
Port
121
Port
121
I/F
123
Port
121
Port
121
Port
121
130
Port
141
Port
141
Port
141
Control Processor
Memory
143
144
Network Controller
142
Protocol Adaptor
140a
Protocol Adaptor
140b
.....
Protocol Adaptor
140b
180b
External Storage Device
Internal Network
170
150a
151
Network Controller
Memory
153
Memory
Control Processor
Control Processor
152
152
Disk Cache
Control Memory
154
155
Port
156
Disk
157
.....
Cache Adaptor
Storage Device
150b
Cache Adaptor
.....
150c
Cache Adaptor
Network Controller
161
Memory
163
Storage
165
Control Processor
162
Control Memory
164
Management Adaptor
I/F
166
160
180a
Port
181
182
Control Processor
Memory
183
Disk Cache
184
Port
185
Disk
.....
186
187
I/F
190
I/F
191
194
Storage
195
Input Device
192
CPU
Service Terminal
193
Memory
Display
196
197
I/F

Fig. 2

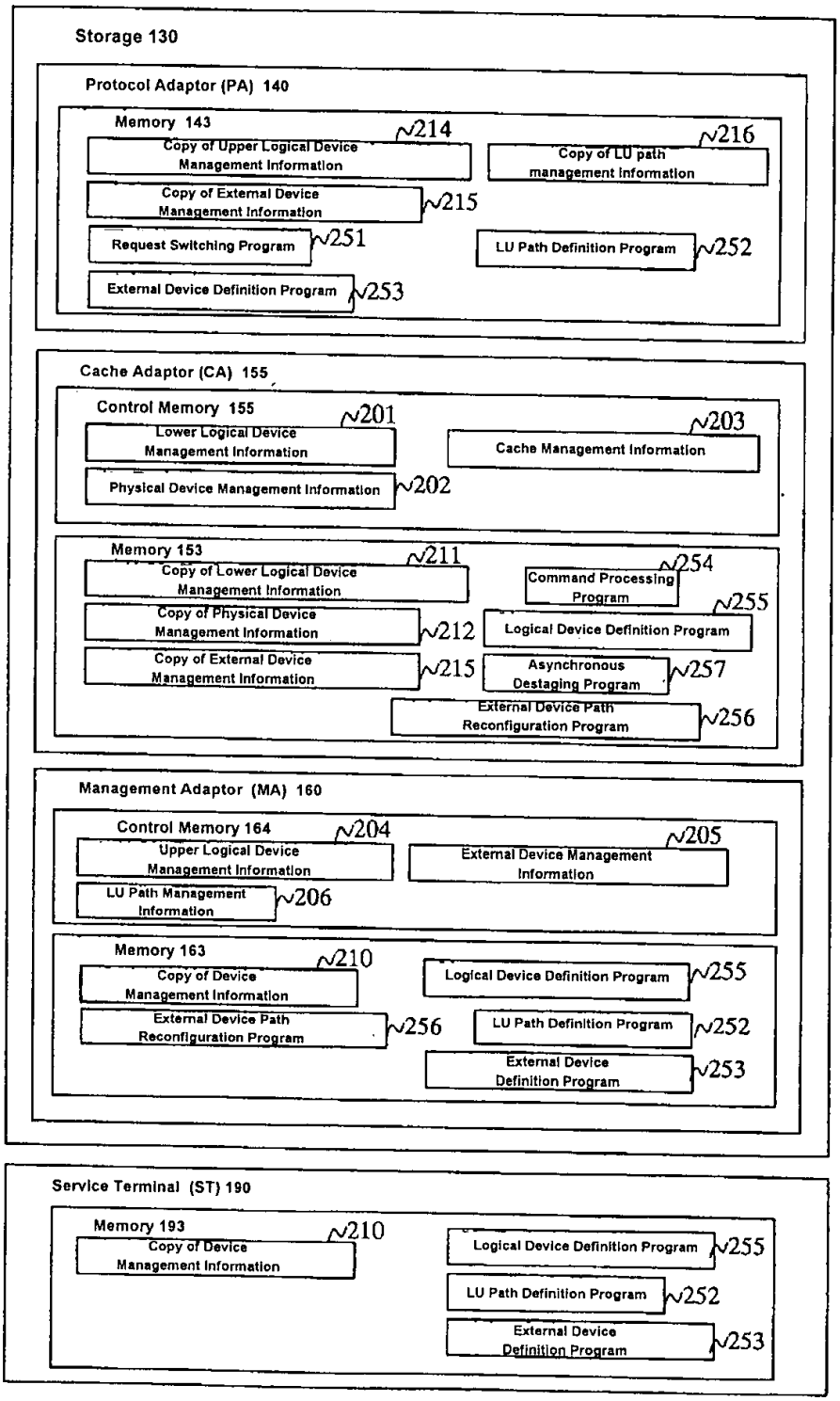

Storage 130
Protocol Adaptor (PA) 140
Memory 143
Copy of Upper Logical Device Management Information
214
Copy of LU path management information
216
Copy of External Device Management Information
215
Request Switching Program
251
LU Path Definition Program
252
External Device Definition Program
253
Cache Adaptor (CA) 155
Control Memory 155
Lower Logical Device Management Information
201
Cache Management Information
203
Physical Device Management Information
202
Memory 153
Copy of Lower Logical Device Management Information
211
Command Processing Program
254
Copy of Physical Device Management Information
212
Logical Device Definition Program
255
Copy of External Device Management Information
215
Asynchronous Destaging Program
257
External Device Path Reconfiguration Program
256
Management Adaptor (MA) 160
Control Memory 164
Upper Logical Device Management Information
204
External Device Management Information
205
LU Path Management Information
206
Memory 163
Copy of Device Management Information
210
Logical Device Definition Program
255
External Device Path Reconfiguration Program
256
LU Path Definition Program
252
External Device Definition Program
253
Service Terminal (ST) 190
Memory 193
Copy of Device Management Information
210
Logical Device Definition Program
255
LU Path Definition Program
252
External Device Definition Program
253

Fig. 3

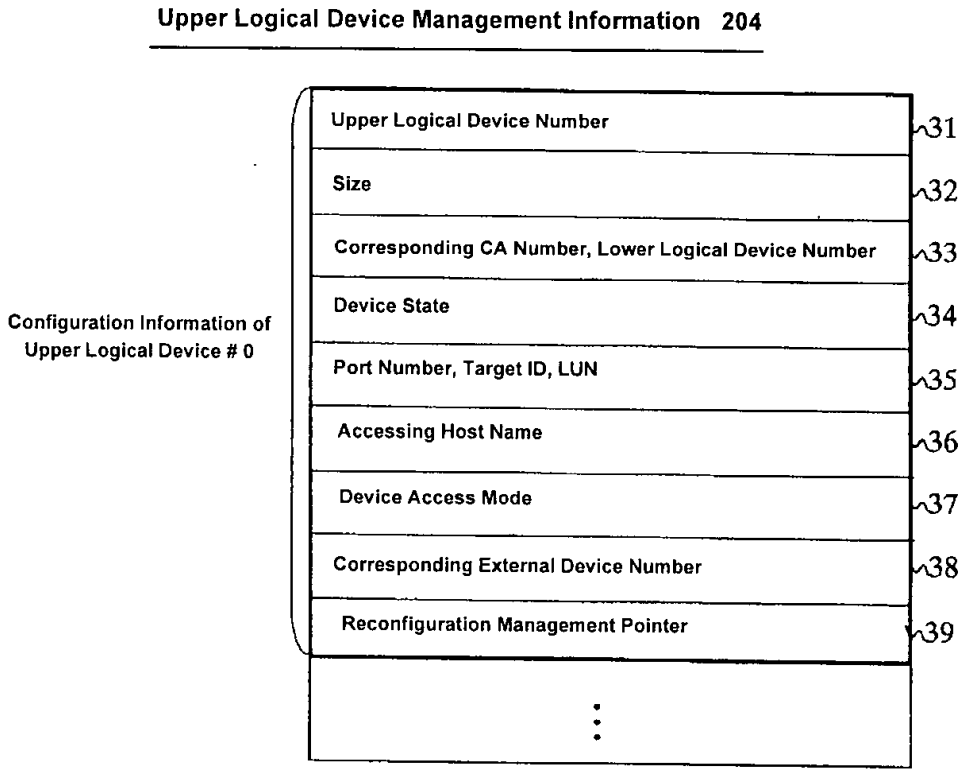

Upper Logical Device Management Information 204
Configuration Information of Upper Logical Device # 0
Upper Logical Device Number
31
Size
32
Corresponding CA Number, Lower Logical Device Number
33
Device State
34
Port Number, Target ID, LUN
35
Accessing Host Name
36
Device Access Mode
37
Corresponding External Device Number
38
Reconfiguration Management Pointer
39

Fig. 4

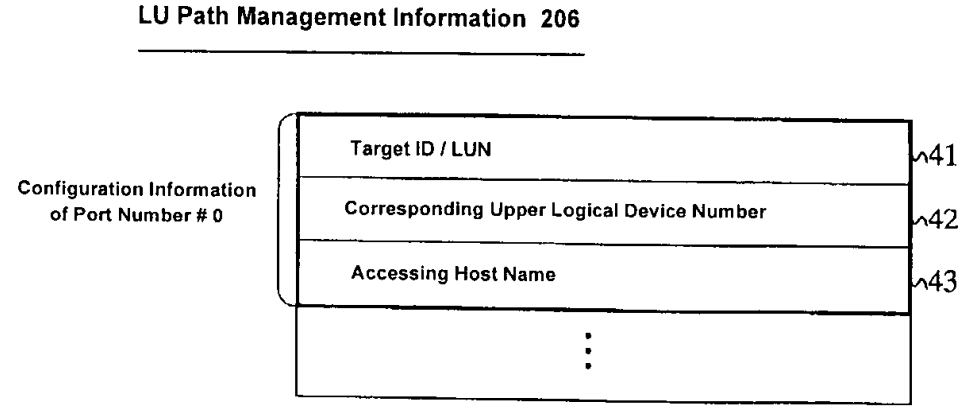

LU Path Management Information 206
Configuration Information of Port Number # 0
Target ID / LUN
41
Corresponding Upper Logical Device Number
42
Accessing Host Name
43

Fig. 5

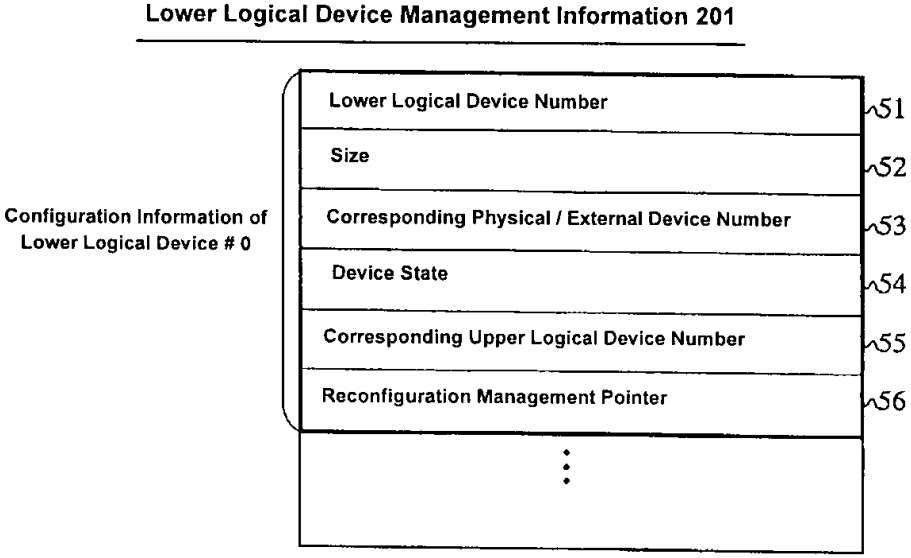

Lower Logical Device Management Information 201
Configuration Information of Lower Logical Device # 0
Lower Logical Device Number
51
Size
52
Corresponding Physical / External Device Number
53
Device State
54
Corresponding Upper Logical Device Number
55
Reconfiguration Management Pointer
56

Fig. 6

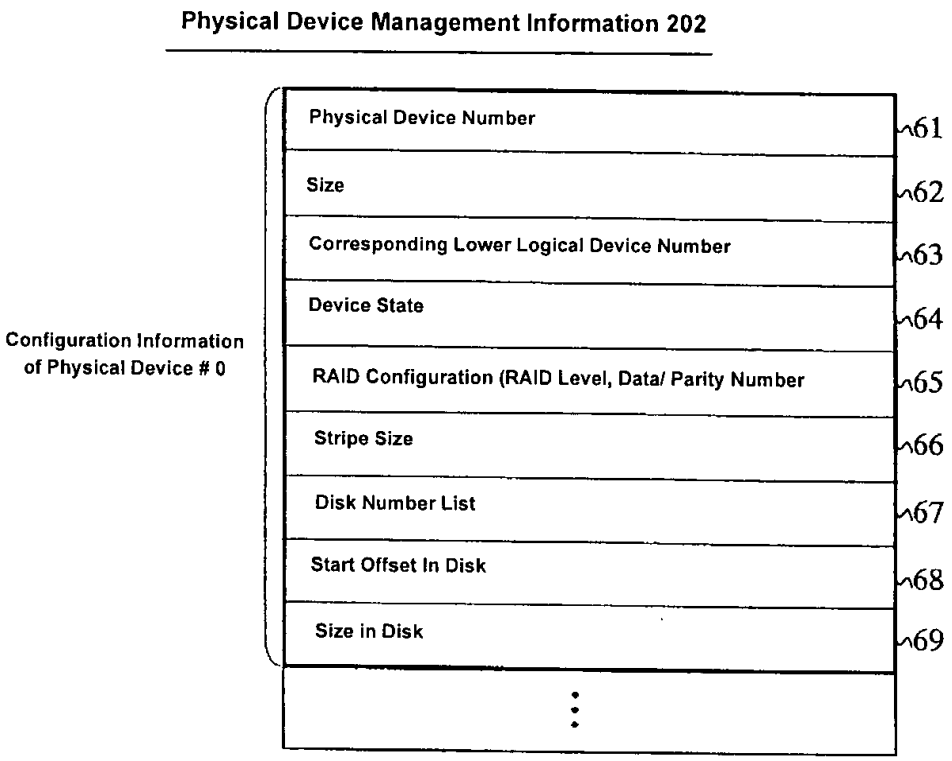

Physical Device Management Information 202
Configuration Information of Physical Device # 0
Physical Device Number
61
Size
62
Corresponding Lower Logical Device Number
63
Device State
64
RAID Configuration (RAID Level, Data/ Parity Number
65
Stripe Size
66
Disk Number List
67
Start Offset In Disk
68
Size in Disk
69

Fig. 7

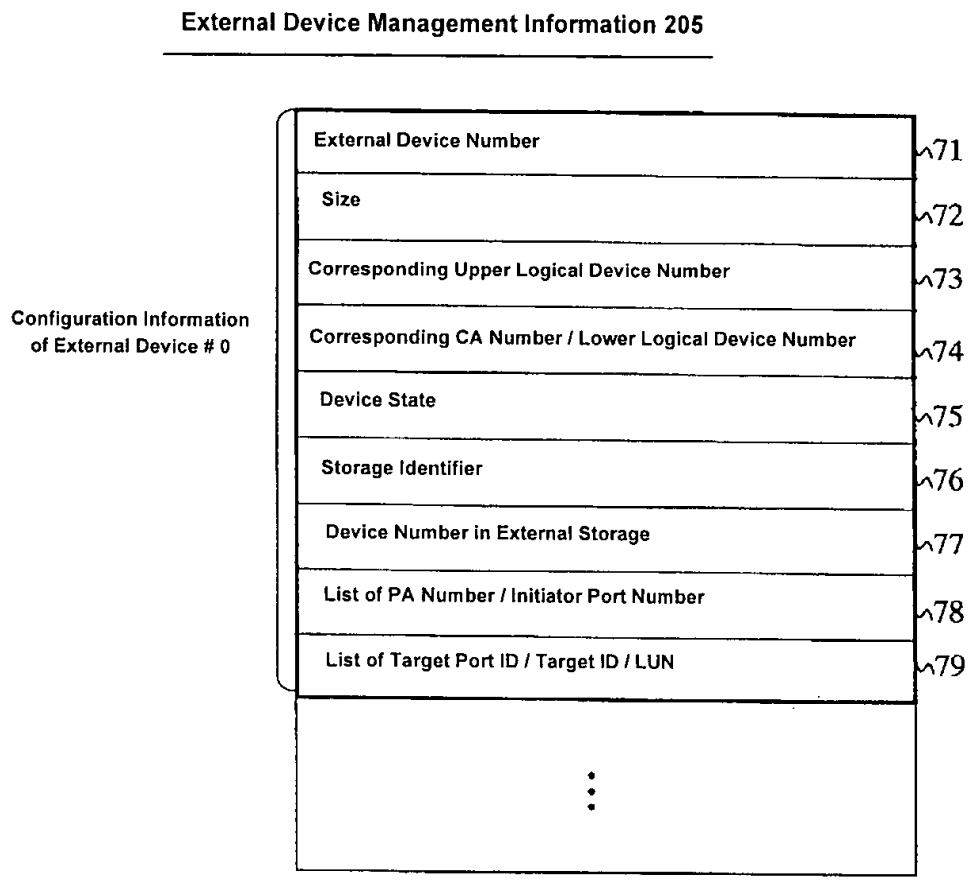

External Device Management Information 205
Configuration Information of External Device # 0
External Device Number
71
Size
72
Corresponding Upper Logical Device Number
73
Corresponding CA Number / Lower Logical Device Number
74
Device State
75
Storage Identifier
76
Device Number in External Storage
77
List of PA Number / Initiator Port Number
78
List of Target Port ID / Target ID / LUN
79

Fig. 8

External Device Definition Processing 253

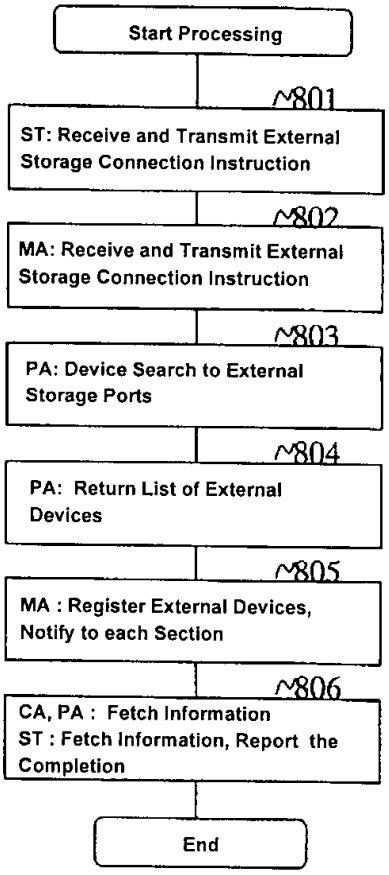


Fig. 9

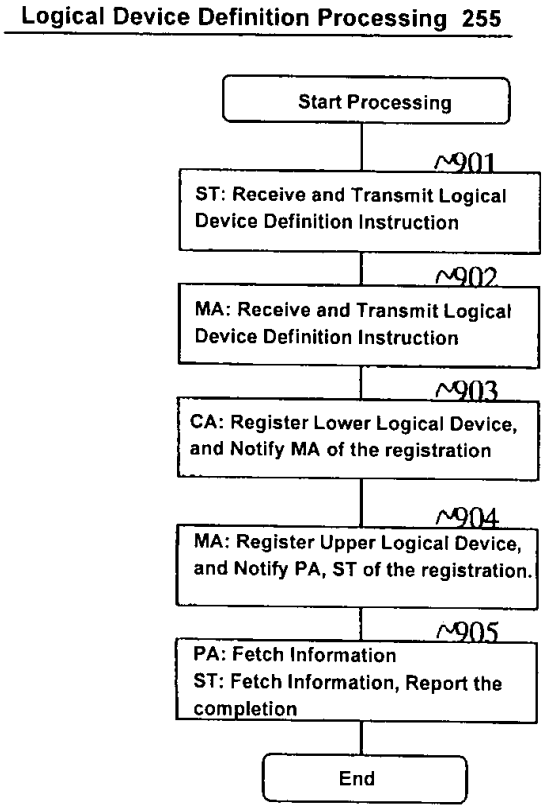

Logical Device Definition Processing 255
Start Processing
901
ST: Receive and Transmit Logical Device Definition Instruction
902
MA: Receive and Transmit Logical Device Definition Instruction
903
CA: Register Lower Logical Device, and Notify MA of the registration
904
MA: Register Upper Logical Device, and Notify PA, ST of the registration.
905
PA: Fetch Information
ST: Fetch Information, Report the completion
End

Fig. 10

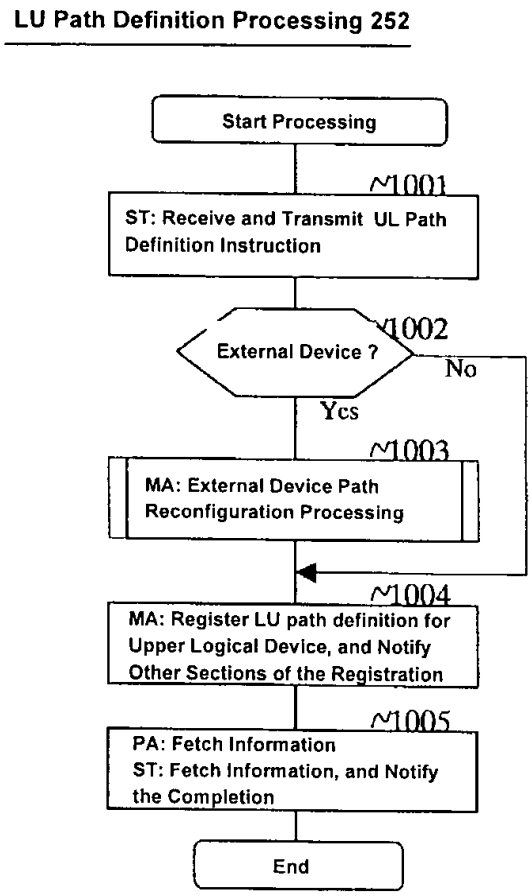

LU Path Definition Processing 252
Start Processing
1001
ST: Receive and Transmit UL Path Definition Instruction
1002
External Device ?
No
Yes
1003
MA: External Device Path Reconfiguration Processing
1004
MA: Register LU path definition for Upper Logical Device, and Notify Other Sections of the Registration
1005
PA: Fetch Information
ST: Fetch Information, and Notify the Completion
End

Fig. 11

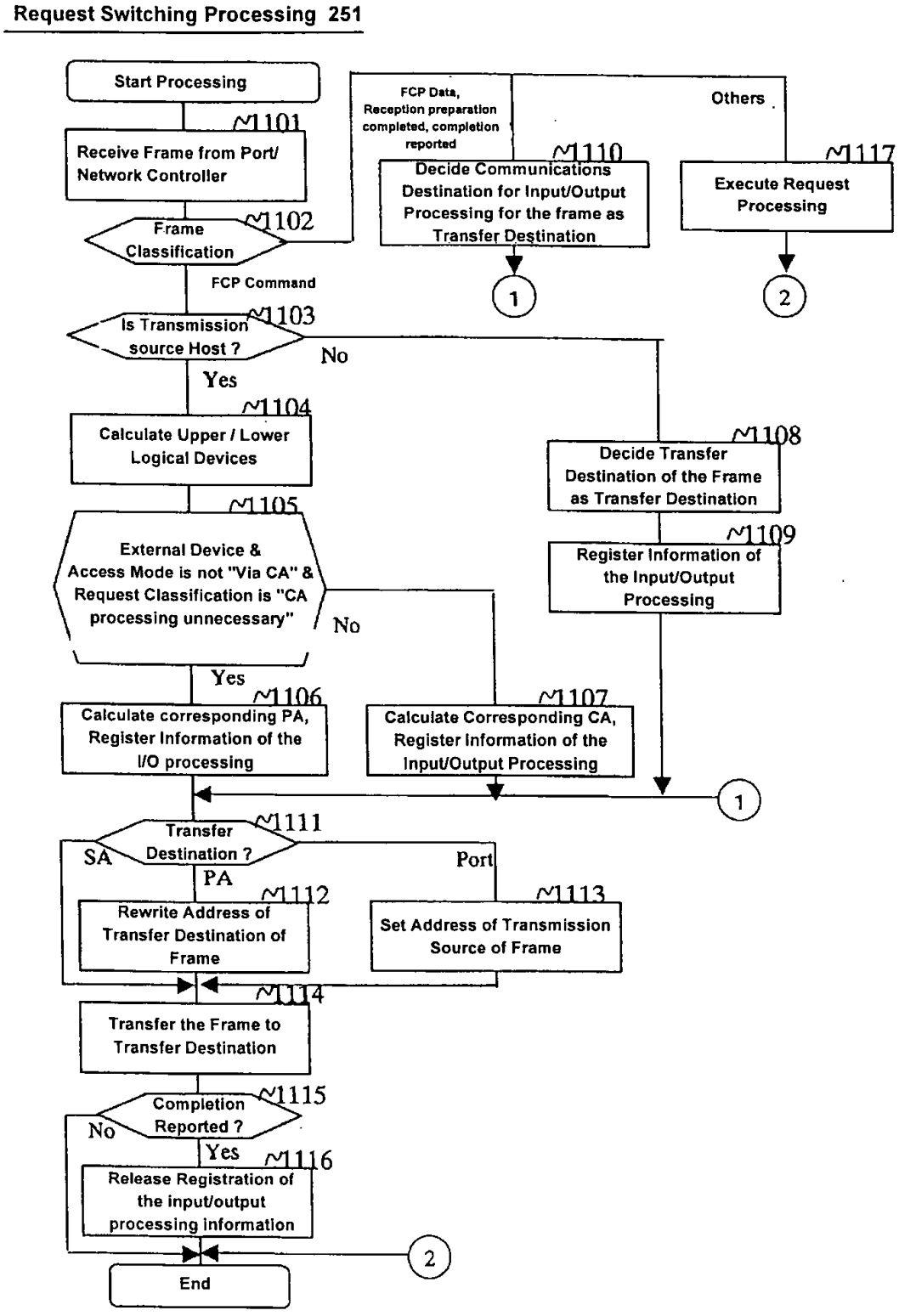

Request Switching Processing 251
Start Processing
1101
Receive Frame from Port/ Network Controller
1102
Frame Classification
FCP Command
1103
Is Transmission source Host ?
No
Yes
1104
Calculate Upper / Lower Logical Devices
1105
External Device & Access Mode is not "Via CA" & Request Classification is "CA processing unnecessary"
No
Yes
1106
Calculate corresponding PA, Register Information of the I/O processing
1107
Calculate Corresponding CA, Register Information of the Input/Output Processing
1111
Transfer Destination ?
SA
PA
Port
1112
Rewrite Address of Transfer Destination of Frame
1113
Set Address of Transmission Source of Frame
1114
Transfer the Frame to Transfer Destination
1115
Completion Reported ?
No
Yes
1116
Release Registration of the input/output processing information
End
FCP Data, Reception preparation completed, completion reported
Others
1110
Decide Communications Destination for Input/Output Processing for the frame as Transfer Destination
1117
Execute Request Processing
1
2
1108
Decide Transfer Destination of the Frame as Transfer Destination
1109
Register Information of the Input/Output Processing
1
2

Fig. 12

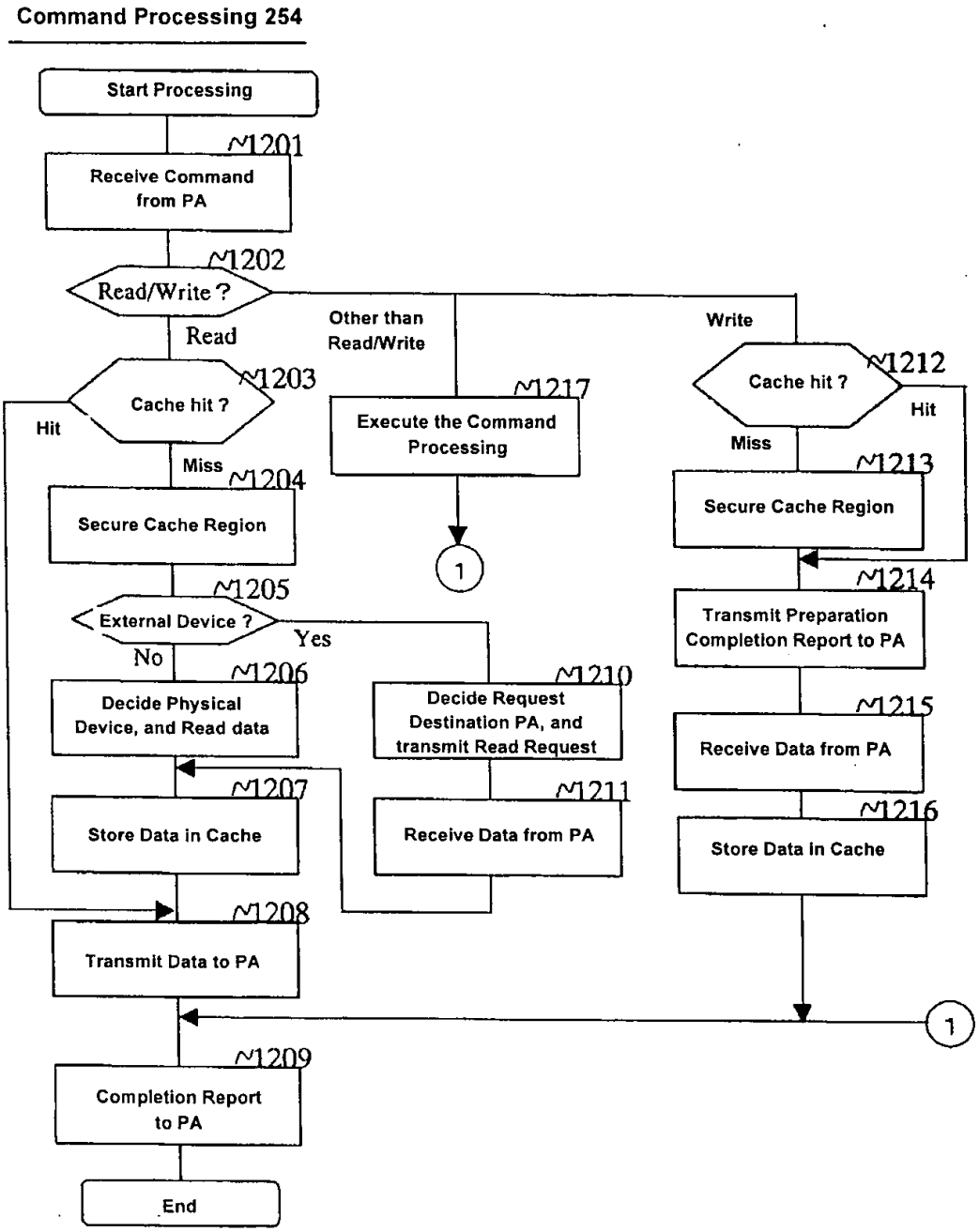

Command Processing 254
Start Processing
1201
Receive Command from PA
1202
Read/Write ?
Read
Other than Read/Write
Write
1203
Cache hit ?
Hit
Miss
1204
Secure Cache Region
1205
External Device ?
Yes
No
1206
Decide Physical Device, and Read data
1207
Store Data in Cache
1208
Transmit Data to PA
1209
Completion Report to PA
End
1217
Execute the Command Processing
1
1210
Decide Request Destination PA, and transmit Read Request
1211
Receive Data from PA
1212
Cache hit ?
Hit
Miss
1213
Secure Cache Region
1214
Transmit Preparation Completion Report to PA
1215
Receive Data from PA
1216
Store Data in Cache
1

Fig. 13

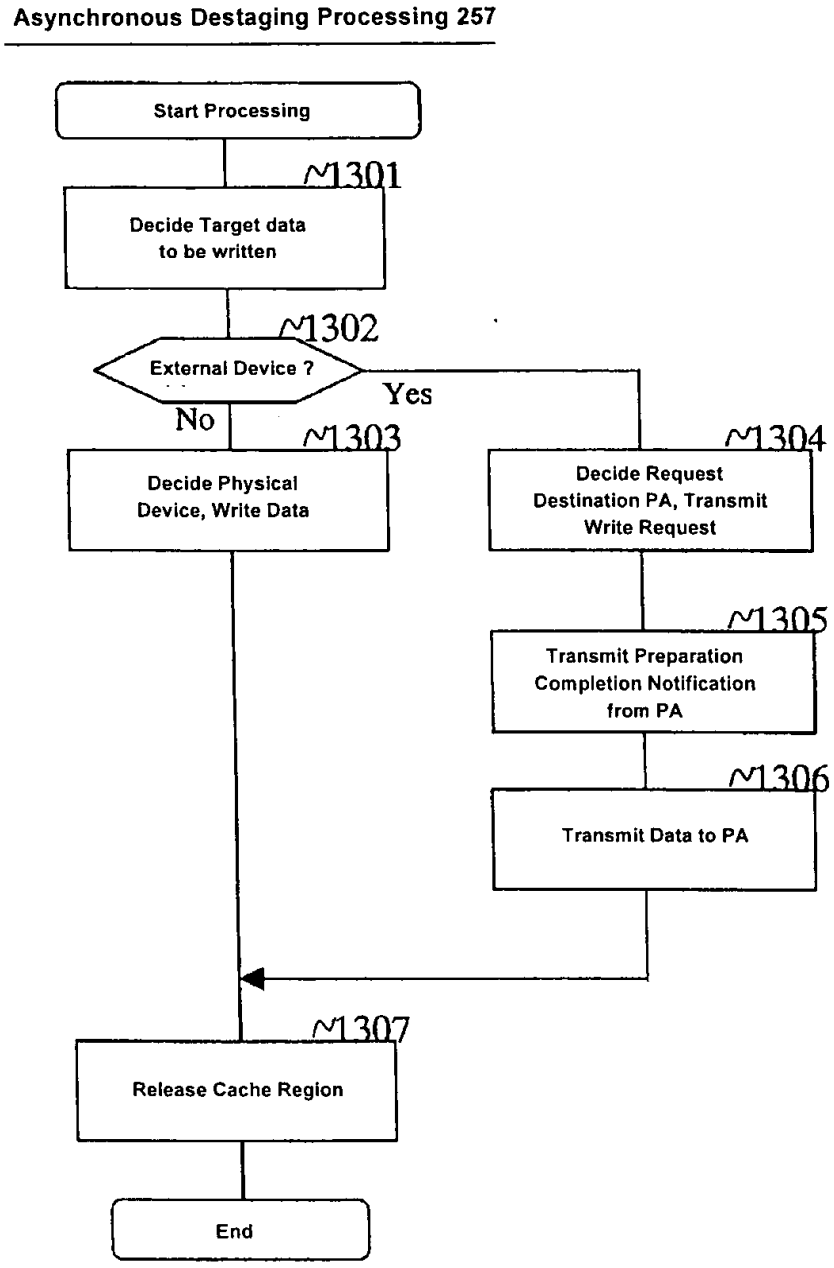

Asynchronous Destaging Processing 257
Start Processing
1301
Decide Target data to be written
1302
External Device ?
Yes
No
1303
Decide Physical Device, Write Data
1304
Decide Request Destination PA, Transmit Write Request
1305
Transmit Preparation Completion Notification from PA
1306
Transmit Data to PA
1307
Release Cache Region
End

Fig. 14

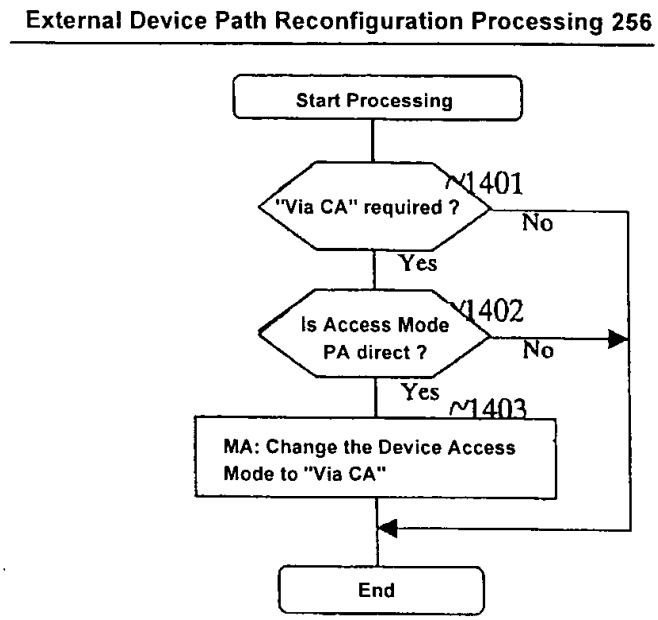

External Device Path Reconfiguration Processing 256
Start Processing
"Via CA" required ?
1401
No
Yes
Is Access Mode PA direct ?
1402
No
Yes
1403
MA: Change the Device Access Mode to "Via CA"
End

Fig. 15

External Device Path Reconfiguration Processing 256

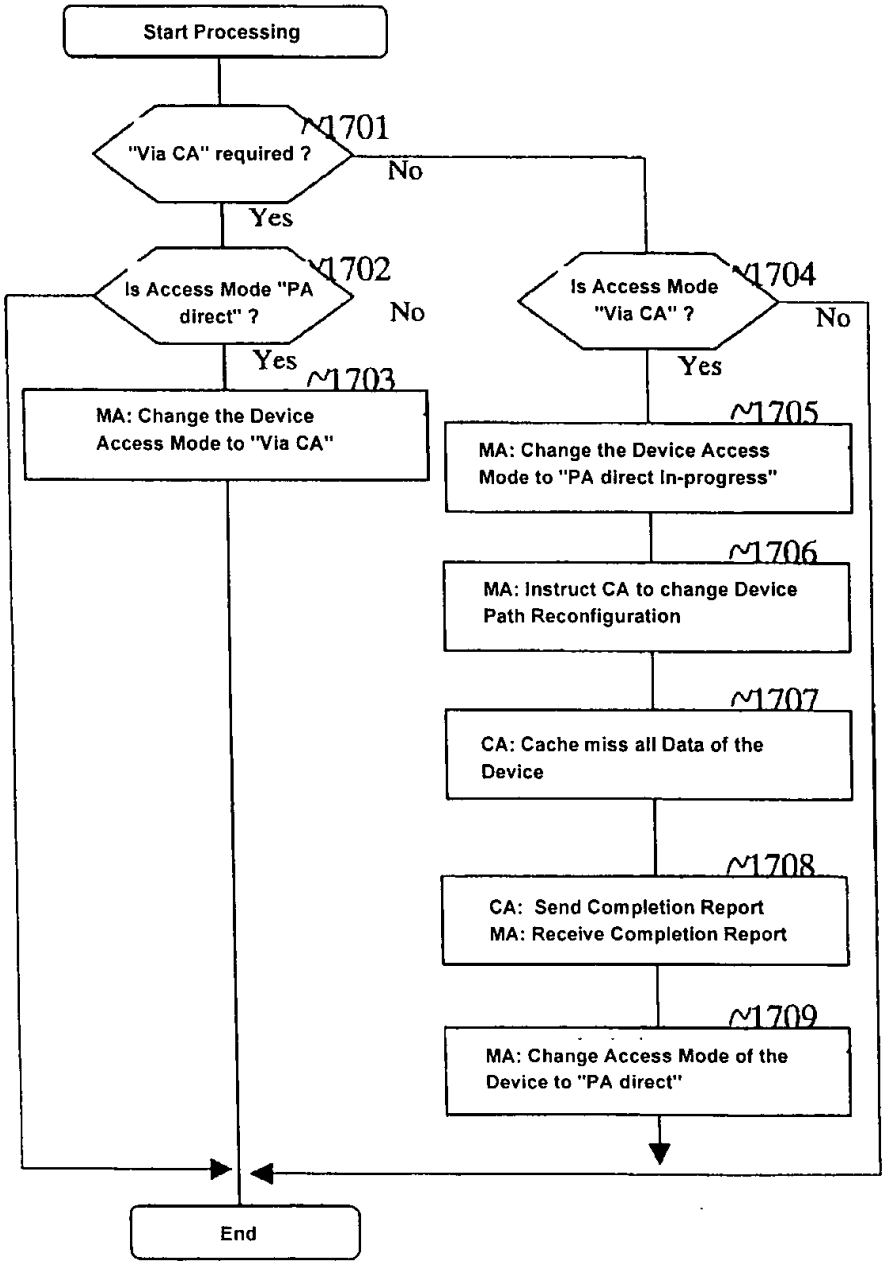


Fig. 16

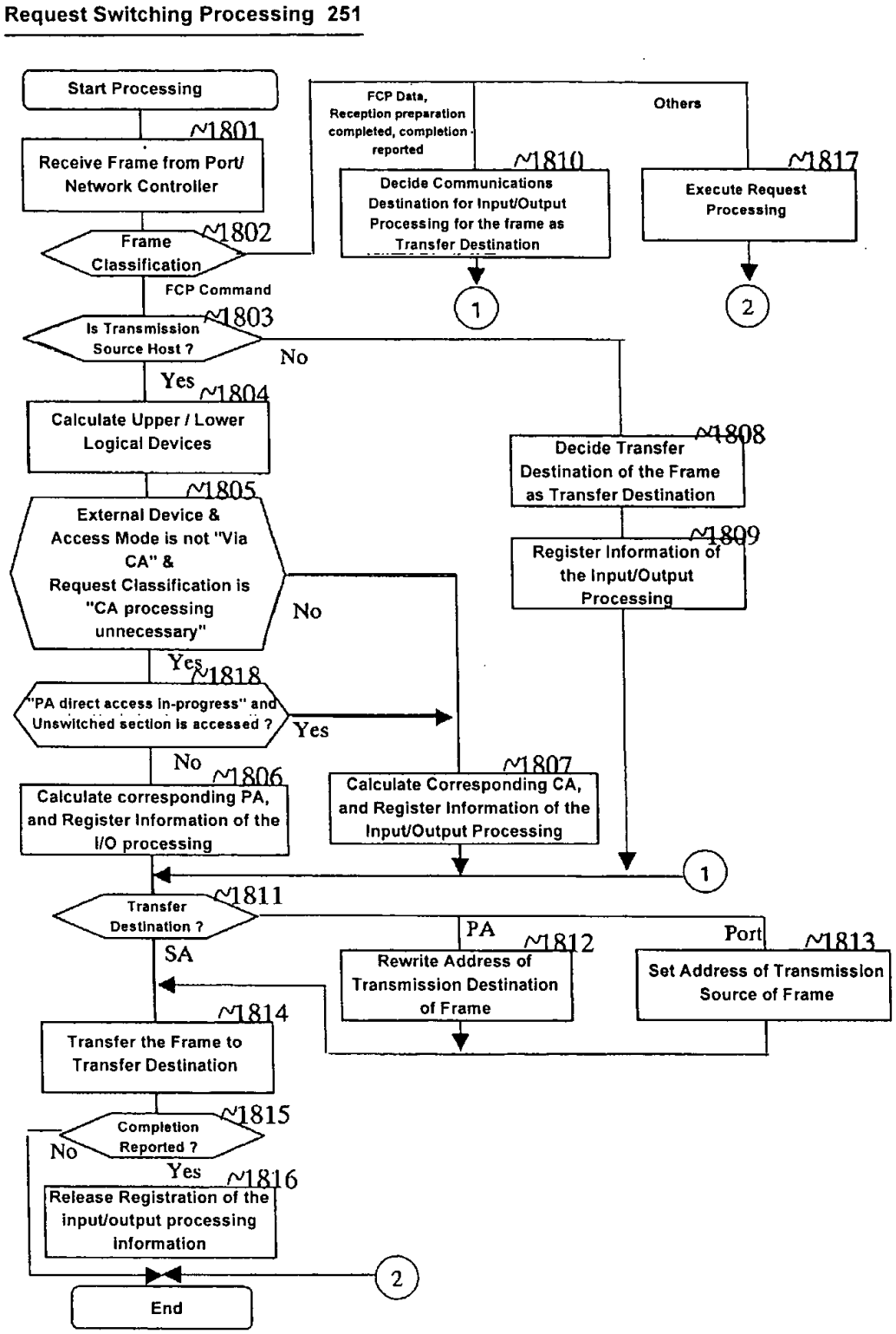
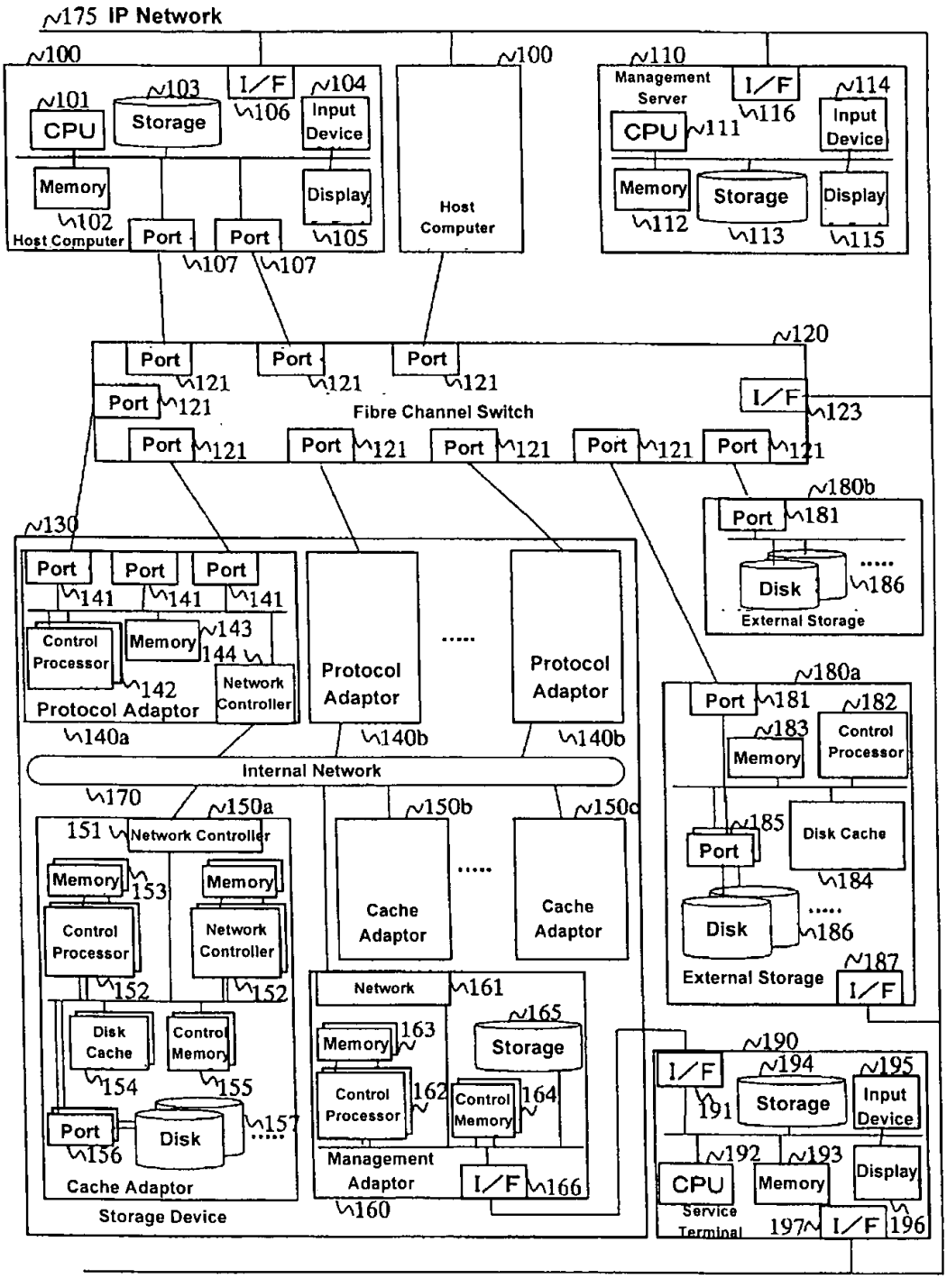

Request Switching Processing 251
Start Processing
1801
Receive Frame from Port/ Network Controller
1802
Frame Classification
FCP Command
1803
Is Transmission Source Host ?
No
Yes
1804
Calculate Upper / Lower Logical Devices
1805
External Device & Access Mode is not "Via CA" & Request Classification is "CA processing unnecessary"
No
Yes
1818
"PA direct access in-progress" and Unswitched section is accessed ?
Yes
No
1806
Calculate corresponding PA, and Register Information of the I/O processing
1807
Calculate Corresponding CA, and Register Information of the Input/Output Processing
1811
Transfer Destination ?
SA
PA
1812
Rewrite Address of Transmission Destination of Frame
Port
1813
Set Address of Transmission Source of Frame
1814
Transfer the Frame to Transfer Destination
1815
Completion Reported ?
No
Yes
1816
Release Registration of the input/output processing information
End
FCP Data, Reception preparation completed, completion reported
Others
1810
Decide Communications Destination for Input/Output Processing for the frame as Transfer Destination
1817
Execute Request Processing
1
2
1808
Decide Transfer Destination of the Frame as Transfer Destination
1809
Register Information of the Input/Output Processing
1
2

Fig. 17


175 IP Network
100
CPU
101
Storage
103
I/F
106
Input Device
104
Memory
102
Host Computer
Port
107
Display
105
Host Computer
100
Management Server
110
CPU
111
I/F
116
Input Device
114
Memory
112
Storage
113
Display
115
120
Port
121
Fibre Channel Switch
I/F
123
180b
Port
181
Disk
186
External Storage
130
Port
141
Control Processor
Memory
143
144
Network Controller
142
Protocol Adaptor
140a
Protocol Adaptor
140b
Protocol Adaptor
140b
180a
Port
181
182
Control Processor
183
Memory
185
Disk Cache
184
Disk
186
External Storage
187
I/F
Internal Network
170
150a
151
Network Controller
Memory
153
Control Processor
Network Controller
152
Disk Cache
154
Control Memory
155
Port
156
Disk
157
Cache Adaptor
Storage Device
150b
Cache Adaptor
150c
Cache Adaptor
Network
161
Memory
163
Storage
165
Control Processor
162
Control Memory
164
Management Adaptor
160
I/F
166
190
I/F
191
194
Storage
195
Input Device
192
CPU
Service Terminal
193
Memory
Display
197
I/F
196